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Social Purposes in Education ¹

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IT IS a very great pleasure for me to be here and to meet with the influential teachers in such an historic spot and school, which has such an old, such a fine record for educational work. I assure you it adds to my satisfaction to meet you on this particular spot, on this particular occasion.

In speaking of the social purpose in education, I do not intend to make any arguments about the importance of the social aim of the school, or to give the reasons why the social purpose is important. If I were talking to inexperienced teachers, those who are still in training, I might think it necessary, or worth while, to go into that. But I take it for granted that we all admit that, so far as our common school system of education is concerned, the main business must be to prepare the boys and girls and young men and women who come to these schools to be good citizens, in the broadest sense. These pupils must be prepared to be members of communities, recognizing the ties that bind them to all the other members of the community, recognizing the responsibility they have to contribute to the upbuilding of the life of the community. I shall assume that as axiomatic. I shall ask you to consider some of the aspects of the social purpose in education, to analyze some of the elements that enter in to the social aim of public educational work.

There are three phases of the social aim in education to which I wish to call attention. The first is the purpose that which we most ordinarily associate with the word "citizen." We think of the citizen in a political capacity, and sometimes we restrict the idea of being a good citizen to the political relations, duties and responsibilities of the person, his relations to the government of the country as a whole and to his own local

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government. I think that is only a part of good citizenship. I think that we ought to have a good citizenship, wide enough to cover all of the relations which the individual sustains to all the other members of the community. The political aspect is an important one, and one that is increasingly important for the public schools of the country to emphasize. It is an aspect of education in which the teachers, it seems to me, must be more deeply grounded and more widely interested than they have been in the past, if we are to maintain our democratic experiment.

For a great many years, the democratic undertaking or political enterprise in this country had a self-starter, so to speak, and it worked rather automatically. The enterprise almost took care of itself, barring special problems like the slavery question, as long as there was plenty of land and people could keep moving on to the frontiers. Our European critics said long ago that the strain on our democratic institutions would not come until the population had so increased that there was practically no more unused land ready to be taken up; when the resources of the country had all come under private ownership, and the industrial and economic conditions of making a living had become more what they were in the old world. They said that then the real trial of our democratic institutions would come. We all know that our present political problems are serious. They require more intelligence, and are more complex than they ever have been in the past. We cannot rely upon the momentum of our democratic enterprise to conduct itself to the goal.

The emphasis upon practical instruction in civics, knowledge of government, duties of citizenship, and the like, have not increased for a good while. Speaking on the whole, I think we have to admit candidly that we have been inclined to assume that good political citizenship would be obtained if pupils had sufficient information about the nature of our government and about the way in which the government is conducted. If we grounded our pupils in the public schools in the knowledge of the Constitution of the Nation and the main points in the Constitution of the Commonwealth in which they live, and taught them something of the government of their own locality, we thought they were going to be prepared to do their part and

take their share as good citizens in the carrying on of the government. All of this concerns simply machinery. The machinery of government is very important, but even more important is the power that works that machinery; the nature of that power; where the power comes from. Even the best theoretical institution of government is after all a tool, an instrument which does not generate its own force. There has to be some power that comes into this machinery from outside. We can instruct our pupils from top to bottom in the nature of our government, in the details of its theories, management; we can make them familiar with the Constitution, not only verbally, but give them insight into the functions and duties of the local government, and yet have, after all, just a paper preparation.

We find in this method the danger that attends so many phases of our education, namely, thinking we have educated when we have simply given information about something. So we think when we have given information to the students about the structure and workings of the government, we have somehow done our part as educators in preparing them to be good citizens when they enter into public life; to become actual citizens when they go out from the school in the future.

I think we have allowed our students too largely to go out with not only a paper knowledge, but in too innocent a frame of mind; especially too innocent a frame of mind about the power and source of the power that has to be applied to work the governmental machinery. We have not gone back of the machinery to any great extent in our instruction to get the pupils to familiarize themselves with the problem that they will have to meet as citizens. So far as the teaching in the past has been concerned, the effect has been to leave the students with the feeling that they really did not have to solve the problems; that the problems were solved by the officers of our government and the makers of our Constitution; so that all they have to do is to vote for a good man and attend, perhaps, caucuses. They have been led to believe that the rest will take care of itself. The great mass of the students, therefore, as they leave school, go out into life, even if they are fairly posted about the structure and theoretical working of the government, without any knowledge of the directing forces they

will have to meet. I do not mean that our pupils should be put in a fault-finding or critical attitude about our political institutions. I do think there has been a temptation to idealize our institutions,—idealizing them in the sense of glossing over, or keeping away from the students' minds, as they mature, a sense of what the problems are that make it difficult to carry on our government successfully. We need methods of teaching that will not merely give pupils a simple paper knowledge of the government, but that will give them, as they go forth, a knowledge of what are the underlying tendencies and problems they must meet in government, local, state and national.

If the young men and women go forth from our schools without any instruction by competent, sympathetic teachers as to the defects and dangers in the working of our political machinery, they are confused and perplexed when they are confronted by active problems, and they are very often victimized. Some people ask why it is that the products of our schools, even higher schools and universities, are so easily led to the acceptance of low political standards. One of the great political bosses of this country, who recently died, was a representative, and a scholarly representative, of one of our finest universities. He set out as something of a reformer, but in the end he devoted all of his great skill simply to the manipulation of a political machine. I wonder if some of our difficulty is not because our students have gone out in too innocent a frame of mind.

I realize that this is a somewhat delicate matter for teachers of citizenship, which includes all teachers of civics, American history, and geography of the country. I know it is a delicate matter for these teachers to introduce too much direct discussion of the real problems. It is very much safer to stick to teachings of the text of the Constitution, and of the various officers of the state, of the municipality, and village; to catalogue what their various functions are supposed to be, and then assume that everything is working smoothly. But it seems to me that if anybody is in a position to introduce the future citizens, in a wise and impartial way, to these problems which the students will have to meet, it is the school teachers. Until the school teachers do this we shall have to admit that they are not taking their full responsibility.

I think, furthermore, if teachers had more courage about some of these questions, they would be more respected and more influential in the community than they otherwise would be. In the end, people are taken pretty much on their own valuation. If the teaching body insists upon recognizing that it has a responsibility in dealing in a concrete way with the political problems of the community, the communities throughout the country would respect the teaching body more if they did deal with our political and social problems in a frank and more concrete way.

I happened to hear a story this summer dealing with a contemporary problem. A teacher had to exercise her moral courage in one of our southern or border states, where the high school had become somewhat under suspicion because they had a very liberal teacher in science who included the theory of evolution. That community had been told the evils and dangers of the doctrine. When the high school commencement was to be held they had no hall in the school, and none of the churches would permit their rooms to be used for the high school commencement because of the dangerous teachings of natural science in that school. The superintendent there, who was a woman, got her father's barn and arranged for the commencement to be held there. Some of the good people of the town were rather ashamed, and they offered their church. This woman then insisted that it be carried through for the sake of publicity. They had a successful commencement in the barn. I think that school stood higher in that community because it had not simply yielded to the local wave of opinion, even of very respectable people, than it would have stood if it had compromised and taken a colorless and neutral position on a matter on which very good people in the community differed. I think the same is true in dealing with the more concrete political issues.

We do not let our students in schools realize enough, in the way we teach history and civil government, the many good and bad connections that there are between business and political interests in our cities. One hardly dares to travel on the railway today,¹ because one does not know what is going to happen. We have before us, on a very large scale, the close connection

¹ This was during the railway strike.

that there is between the national government and great industrial and commercial interests, such as the railways and coal mines. It is not necessary that the teachers take sides in such situations and try to persuade their students as to who is right or wrong in the controversy between the labor people and the railway managers, the coal miners and the operators. We have here an instance to show how close together are the political life of the nation and that of the industries. These great industries touch so intimately transportation, coal mining, etc., which influence every aspect of our social life. They inevitably create certain problems for government. It seems to me, therefore, that if we really are going to make good citizens in the teaching of history and government, we need to discuss these points of contact between industry, especially the large organized industries of the country on the one hand, and the concrete political problems that have to be dealt with, so as to give the students some idea of how these two things act and interact.

To go back to what I said first: Here is the political machine, but where does the power come from that runs that political mechanism? We, as adults, actually learn more and more how much of that power is supplied directly through commerce and industry, because of the dominant place that commerce, industry and finance occupy in our modern life. If teachers neglect this point, either because they are not sufficiently conscious of it, or because they think it is too delicate a matter, and therefore, lack the moral courage for the discussion of these things, I don't believe we can pride ourselves upon really preparing our student body to make good citizens from the political point of view. We are preparing a somewhat passive body of citizens who will be managed and exploited either by political machines, or, in reaction against them, by demagogues and agitators who make appeals to them for their own special purposes. We need to develop in the coming generation a much more discriminating judgment about political problems and plans, if our public schools are going to train our people so that they will really make our democratic experiment a complete and adequate success.

We have passed the period when we can count upon general education, in the sense of reading, writing, some history, geog-

raphy, the rudiments of science, to give the kind of intelligence needed in our modern very complicated situations. We must get a more concrete and vital knowledge to our students of the issues that they are going to meet. We not merely have the question of the force that comes into the political structure and keeps it going, but we have the question of the material that enters in. A weaving machine may turn out cotton, silk, or woollen. If it turns out woollen goods, they are shoddy or all wool according to the material that enters into the machine. We cannot content ourselves with learning what is the political structure of our institutions. We must make our students realize that, after all, it depends upon the quality of the goods that the political machine turns out. Poor institutions have worked well when they have had persons of intelligence back of them. So the highest type of institutions work very badly or break down if there is a poor quality, shoddy quality, of human material entering into it.

The second aspect of social aim or purpose of education, I have already touched upon indirectly. That is the industrial. It is certainly very necessary, in order to be a good citizen, to be capable of one's own support. Most people, as they grow older, have others dependent upon them. They have children to look after, so that they must be able not only to look after and support themselves, but also to support, many of them, a certain number of dependents. Public education, public schools, the common schools, of necessity represent a very definite type of education. They are supported by the community and have general social ends to meet, among them the training of the individual to take care of himself, industrially and economically, and to take care of those who are dependent upon him. For public education, at least, this economic necessity, the necessity of making a living, imposes very definite burdens upon the school, and very definitely fixes the direction in which the school activities should go. I do not mean by that, that education should be exclusively or mainly vocational in any narrow sense of the word, but I do mean that the public system of education should not lose sight of the fact that presumably every normal boy or girl, young man or woman, is going to have some calling in life.

You know the old story about the contact of the American

with the European. The European said, "The trouble with your country is that you have no leisure class." "Oh, yes," replied the American, "we have, but we call them tramps." Unless a person is a tramp or parasite of some sort, belonging to the idle rich, more unfortunate than the idle poor, the individual is going to have some calling in the home or out of the home. Certainly education should have some bearing on this fact.

We make a great mistake if we take the idea of vocation in a narrow sense, and think we can solve the problem of the place of the social problem in education by preparing individuals for this and that particular trade. That is not what I mean. I mean almost anything but that. The most modern trades have been so invaded by the machine that a large part of the ordinary operator's work can be learned in a very few weeks. The experience of the ordinary operators in a modern factory is, that after two or three weeks they can manage their machines as well as when they have been at it a year or two. It is futile, therefore, to suppose that simply by training people for highly specialized trades we can solve the question of making them good, fit, working members of society. Rather, what is needed, is a development of certain elements of character.

If you look at the "want" advertisements in the newspapers, where employees are desired, and make a statistical inquiry, comparing the number that ask for special technical skill with those that ask for initiative, personality, integrity and industry, you will find that, after all, from the standpoint of the man who is advertising for workingmen, it is the broad, human qualities of character that make the person competent rather than the more technical elements of training.

There is perhaps some danger that enthusiasm for vocational education will produce a kind of social belief in social predestination, the belief that teachers and the school can select the particular niche or place in society that a person is going to occupy later on. I have seen things to this effect written by educators of repute. These persons made a distinction between captains of industry and the rank and file, and assumed that the school should do the same; that it should educate a few for managing ability, and prepare the rank and file, the

majority, to be the hewers of wood and drawers of water. To take people on the basis of class divisions is against the democratic idea of society. Even the most ardent believers in the old doctrine of predestination, at least left it to divine power and insight to do the predestining. We should be very cautious in this matter of industrial and vocational education not to usurp the place of divinity in supposing that we can foresee what the future social situation of any human being is going to be. We need to educate our youth, so far as it is humanly possible, so as to equip them with initiative, resourcefulness, and with a knowledge of the fundamental principles that will enable them to be intelligent, to see what they are about when they get into industry.

The trouble at present is that so many of our youth leave school early in life, at 14 or 15 years of age. Their school education is completed. Perhaps they have done well if they have gone to the fifth or sixth grade. They then go out into industries that are highly mechanical in character. You may remember somebody, a year or two ago, classified the American people as a nation of seventh graders. In thinking it over, I wonder if he was not a little too optimistic, if he had not set it too high. Perhaps we are fifth or sixth graders. And yet we pride ourselves upon having a national system of education. Some of us here are fathers. What would we think of the education of our children, of that of the children of friends or relatives we are interested in, if they were forced to leave school at the end of the fifth or sixth grade, asserting, "Well, the community says that you are educated; at all events, we will call what you have an education, and send you out into life." And yet we are well satisfied to have the great bulk of children go out from our schools with only that kind, degree and quality of education that can be given at the age of 13 or 14 years of age, generally retarded at that.

The danger that comes from such a situation is increased because so many of these persons go out into purely mechanical branches of industry, and have in the routine of their daily work so little occasion to use any independent intelligence or thought whatsoever. They simply have, first, to take orders from a person, and then, so to speak, take orders from a machine at which they are working. The mechanical routine

that comes from this condition is not calculated to form good material for a republican society. The school must, therefore, do what it can to counteract these hardening and deadening influences of so much of modern industrial life.

I cannot think of any problem which carries more over into the concrete experiences of teachers who are training other future teachers than these two: one, the working out of some method by which the students will be made acquainted with the difficulties and problems of our life in an impartial, but at the same time, frank, honest way. And secondly, that all those who go out into factories and industrial life shall be put on their guard against these deadening influences which will dull their imagination and inventiveness.

It seems to me that the vocational or industrial work of the schools should be directed, not to fitting for any particular calling, but be of the kind that will develop in a youth reserves to meet emergencies, to stand on his own feet, and to use his own hands, directed by his own brain. And the more general work is, the more it calls upon the imagination and the inventiveness and initiative of the individual, instead of simply giving him special work along certain lines, the more the schools will be realizing their social purpose.

The third point is concerned with the fact that in addition to a specific work in life, some social service to render to society, we should also be ready to utilize our leisure hours. Preparation for our leisure is an increasingly important part in training for good citizenship. A good citizen is not simply the man who can vote and use his influence to get good government. He is not the man alone who can render useful service in the profession which he carries on. A really useful citizen is one who can enjoy life and employ his leisure time in a socially profitable way. He is a person who has capacity for appreciation of art, science, history, and literature for their own sake.

Imagine two communities, one of which has good government, honest government, with no corruption. This community has clean homes, hygienic conditions, good schools, good police, and all other things that make up good government. Its people are busy, industrious and honest in their daily occupations. But they are people who, when their leisure moments come,

either during their working hours or after their work, have no capacity for enjoying science, literature, music, or the drama. In the other community we find people who have, in addition to these things enumerated, an interest in more ideal, intellectual and artistic things. You immediately say that the latter community is a higher type of society, a better community; that it recognizes the democratic ideal better than the one that is satisfied when it has good government and efficient workers alone. Training at useful trades is a very narrow view of citizenship, even on the industrial side.

Think of the situation in which so many thousands of people in all our towns are now living. And, of course, our towns are becoming the unit of American life, especially in our eastern states. The bulk of the community, the actual numerical majority of men and women engaged in daily pursuits that are of the routine kind, are living in our cities. There never has been a time in the history of the world when access to amusements was so cheap and so easy. I think this constitutes a very serious situation for thousands of people whose industrial and economic life does not have either soul or spirit. When such persons come from their work into their leisure time, they find themselves solicited by a very great variety of amusements—cheap compared with the situation in the past—which they can afford. Perhaps routine and drudgery have always been fairly common, but the people who did this type of work did not formerly have access to these various kinds of low-cost amusements. I think this is a partial explanation for a good many of the things which people are discussing and deploring at the present time, from the so-called crime wave to the feeling that tastes and interests are deteriorating. Too many people of the community, especially the young people, are concerned merely with having “a good time.” And almost any way to have a good time is regarded as legitimate. We have here, then, a direct problem for the schools to face. The school has not performed its social duty or met its social responsibility until it has equipped the youth of our land for more profitable enjoyment and appreciation of leisure time than is now shown by a great portion of the community.

Whether it is because of our Puritan inheritance, or what it may be, I think we have not taken seriously enough the moral

side of the problem of amusement and recreation. Did you ever stop to think that masses of the people continue to pay for amusement after they have been forced by circumstances to economize in every other direction? The theater, or whatever is the counterpart of the theater, the masses of the people will continue to support when they have been badly cramped in other directions. And it is the people of the community who succeed in giving other people pleasure through acting or singing or playing musical instruments, or even down to lower forms of amusement, such as prize fight spectacles, that call for the attention and financial support of the community. We deplore these things. But I think we should look them in the face and realize what a demand there is in human nature for recreation in leisure time. If there are not desirable forms of enjoyment available, and if people have not been educated to appreciate these higher forms, they will resort to the lower forms.

There is a very great demand now for censorship of all kinds of amusements. I do not know what you think of the desirability of this censorship move. But it certainly indicates that there is a problem. I think, whether you are in favor of more censorship or not, that you will admit that it is a rather external way of meeting the problem. Until everybody is his own censor, instead of having to depend upon someone else, there won't be any genuine reform or development in matters of amusement and appreciation. As long as we have to resort to these external methods of restraining and constraining, it indicates that the educational work of developing the individual, so that he will prefer, of his own accord, the higher forms of enjoyment, has not been done. I am, as you see, discussing the *moral* aspect of the problem of amusement, taking that word in its broadest sense. I am speaking of the enjoyment and best use of the free or leisure time of the entire community. It seems that this should occupy an important place in the social purpose of the school.

These, then, are the three phases of the problem of realizing the social purpose of the school, which I would present to you. I have put the emphasis on the problem, rather than upon any scheme or solution. It is for the teachers, and particularly for those teachers who train our teachers, to work out the concrete

methods by which the plan of government will be made familiar, the specific concrete issues of political life discussed, and the dangers and evils our youth are going to meet, be talked over frankly with them. It is the teachers who have to develop the methods by which pupils are to get that kind of vocational training which shall give them ability to face the complicated conditions of modern life, become masters of their own fate, capable of making their own careers, being active instead of passive economic units. And it is for the teachers, who must work together, to see how the standards of taste and appreciation and capacity to use leisure hours can be improved. We must develop a taste in science or art, not only for those who are going to be scientists or artists, but also for those who, when leisure time comes, will be interested in reading or hearing about something of nature, or literature, or have a capacity to enjoy music and the drama. This will create an active demand for the better things instead of the poorer things. These, I repeat, seem to me to be the three general phases of the problem of realizing the social purpose of the school which teachers, and especially those who are training other teachers, have to deal with.

The Outlook for General Science¹

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RECENTLY a gentleman related to me a story concerning the school life of two members of his family. He stated that interest in science had been stultified in the case of one of his daughters by reason of the fact that she had been compelled to study and attempt to learn many things which made no appeal to her from the standpoint of her present needs, and that they had not been presented in a way interesting enough to have any other appeal. For example, she had been asked to learn the laws governing the expansion of gases as the introductory lesson on the subject, with the obvious result that she was lost in the maze of language which could have but little meaning for her.

With his other daughter, he had had quite a different experience. The teacher had started her in the subject of chemistry with the problem of removing stains from clothing by the aid of the proper chemicals. The one girl started the subject by finding it thoroughly enjoyable, while the other just as thoroughly learned to hate it. What was wrong in this particular case? Certainly not the science. Assuming then, that it was not the pupil, we have left for consideration only the method and the teacher—both closely related in our modern system of education.

Now the subject, Expansion of Gases, can be made as interesting as any fairy tale of literature, and certainly it is a topic of as great importance as that of removing stains from dresses, if only it be presented in as interesting a way. Nearly all of the thousands of motor-cars in use in the world are being driven by the force of expanding gases. How interesting such a subject may be made when so many people are driving their own motor-cars, if each little particle of gas is considered as a rapidly moving projectile battering on the side of the room in which it is enclosed, one side of which being free to move is

¹ Paper presented at the Chicago meeting of the Central Association of Science and Mathematics Teachers, December 1, 1922.

forced out. If a pupil finally deduces certain generalizations that may be called laws, well and good; otherwise, in so far as a first year course in science is concerned, the laws may well be left to themselves.

In spite of the rather strenuous time that General Science has had in the last ten years, I am convinced that it has come to stay, and that it will retain a place in our program of studies. However, it should not be retained unless it can be justified in results which are as demonstrable as those in the case of other high and junior high school subjects. It is rare that we remove a course from the secondary school curriculum. More often do we retain courses long after they have proved failures. A merchant hastens to discontinue an unproductive line of goods. It is not usually so with high school courses of study. As school administrators we have been anxious to show an opportunity for wide election in our program of studies, and as a result, courses have sometimes been retained long after their period of maximum usefulness. We shall be compelled to take stock from time to time and omit those courses that are not productive of desirable results.

The lack of agreement among educators as to what should be embodied in a course in General Science has probably constituted a case against it. This, however, need not be considered serious. The same thing has been true of every one of the courses which we now consider fundamental in our secondary school program. We have had much diversity of opinion on the question of what stress shall be placed on the different divisions of mathematics; on what stress shall be given to formal grammar as a part of the course in English. The social science courses are quite as devoid of uniformity as the courses in General Science. Such a situation is by no means lacking in real advantages. The mere fact that educators are thinking about these courses is evidence that they realize the existence of a problem worth solving. When there is no problem, there is no thinking.

In the first place, we have very few teachers of General Science. There have been few places where training in the subject was possible. The teacher-training institutions have had professors of Physics, Chemistry, Biology and Physiography, but they have had no professors who were attempting

to teach teachers to work in the field of General Science. The result has been the logical one to expect. The urgent demand for General Science teachers has come from the field, and the supply has been woefully inadequate. However, there are still many high school principals who think that any teacher can teach General Science—just as they thought that anyone could teach physical geography and botany. If the history teacher had an incomplete program, it was filled out with classes in ninth year science work, and the results were correspondingly poor.

A few teacher-training institutions have realized the need of courses in this field, but the opportunities for the training of teachers of General Science are still far too few. The teacher who has gone to prepare herself to teach General Science, often has come back a better teacher of one of the sciences. Of course, that is good in so far as it goes, but she still has had little training in the development of a course of study in General Science and the method of presenting it.

The college professors of Science have been slow to recognize General Science as a need. Their work with the more advanced stages of well organized courses of specific sciences has made them hesitate to approve a course of more or less dissociated science. They are doubtless right from their standpoint, but there is another standpoint. Gradually we shall develop teachers who are trained to do this work, and they will develop courses which are sound in pedagogy and content.

Public schools cannot do otherwise than to reflect to some extent the spirit of the times. The last several years have been years of quick change. Methods and ideas have been superseded by others, usually, but not always, for the better. In such times, education shares in the confusion.

Many reasons have been given for the introduction of courses in General Science a few years ago. Not all of these reasons have been good ones, and I shall not attempt to catalog them here. It is sufficient to say that at the present time we have courses in General Science. Are these courses serving the best interests of the pupils who take them? Are they serving the interests of the pupils as well as any other courses for which they may have been substituted? If a negative answer must be given to these questions, we should discard the study of

General Science until such time as we may be able to develop courses which will stand such a test.

Assuming, however, that the answer to the last question is in the affirmative, the next question to be answered is: What changes should be made in our General Science courses in order that they may serve better the needs and interests of the pupils who are to study them?

First, we must decide what pupils are to take these courses. The last few years have shown remarkable increase in the enrollment of grades seven to twelve inclusive. In Cleveland, the increase in these grades since January, 1920, has been 10,771 pupils, or 37.7%, distributed as follows:

	7th	8th	9th	10th	11th	12th
Jan. 1920	9,241	7,448	5,150	3,217	1,962	1,523
Sept. 1922	10,953	9,112	8,457	5,344	3,218	2,227
Increase in						
Per cent	18.5%	22.3%	64.2%	66.1%	64.0%	46.3%

There has been a marked tendency for pupils to remain in school, thus, to some extent, minimizing the argument that these pupils should be given some work in Science in the eighth or the ninth years, since so many of them drop out of school before they reach the upper years and have an opportunity to study the sciences, which are usually placed later in the high school curriculum.

To my mind, if we are going to have courses in General Science, we must justify them on the basis of present needs of the pupils, considering both the habits of study which they may acquire and the residue of content which may remain. In other words, if the course in General Science cannot be justified as the best use that can be made of a certain portion of a pupil's time in the eighth or ninth years, it should be omitted. I have very little sympathy now with the argument that the pupil should be given the work since he should have some science and since he only has one chance in four of remaining until he may get it later. I do not believe that we shall need to worry much about that sort of argument, for, in my opinion, General Science can be justified on the basis that nothing can be substituted for it which will be as valuable to

the pupil, (a) in teaching him the best methods of study, and (b) furnishing him with interesting and valuable content.

The assumption requires that we employ good methods and that we shall have adequate material. The method implies the assurance of the presence in the class-room of teachers who are trained to teach and who have enough knowledge of content to assist in the choice of material and the building of courses of study. The scientists, in their teaching of the sciences which usually come later in the curriculum, have almost without exception placed the values, first, on informational content, and second, on discipline and method of study. With the General Science course in the eighth or ninth year, I would reverse the order and place the method of study as the value of first rank. This, by no means need minimize the value of proper selection of informational content. The pupil should be introduced to the best methods of study; should be assisted and led to develop the scientific attitude toward problems and at the same time be given an opportunity to assimilate the most usable and pertinent scientific facts in the life about him. The method of study will be the most sought for product; the content a most valuable first by-product. This does not mean that we shall pay less attention to the selection of material. It will be a very great waste if we do not select the most worthwhile problems for our pupils to work on. We must do this in order to place the proper emphasis on our first aim—that of developing in him correct methods of study, good habits of mind. We cannot get the best results, either from the pupil or the teacher, unless we have the most vital material.

Man, in his conquest of nature, or, if we would put it differently, in his efforts to establish a co-operative relationship with nature, has gained a vast amount of knowledge which has given him power, enlightenment, security, comfort and pleasure. This store of scientific knowledge has gained for man a progress for each generation which has been beyond the dreams of each preceding generation. The progress of the last century, due to science, has been greater than the progress of all the preceding centuries. It has purified the health of body and mind. It has increased wealth through increased production. It has increased the comforts of our daily lives. It has given us new uses of power. It has increased our daily pleasures. It has

raised new questions in the fields of ethics, which, if solved, will assist us in a better understanding of our moral obligations in the direction of our rights and duties. It is as much a part of our lives as social science, as language or government. In our present civilization it is not enough that the specialist know science. The public must know it, and appreciate it, to secure for itself the results of civilization.

If some science is to be taught, so that certain desirable methods will carry over to other fields, the teacher must possess an adequate training in the method he hopes to inculcate. Much of the failure in General Science teaching has been due to lack of appreciation on the part of teachers of the importance of method, and to an inadequate discriminating knowledge of content. If the teacher is content to let the matter drop with the acquisition of a few facts by the students, the time will be mostly wasted. As soon as we have the teachers, the problem concerning the value of Science as a secondary school study will be solved to a large extent.

Let us assume that we have agreed that General Science will be placed in either the eighth or the ninth year of school work—junior or senior high school, as the case may be. How shall we develop a course of study that will be best for the particular community in which we happen to be teaching?

If we are to reach any decision concerning the methods and materials of a course of study, we must reach a rather definite agreement on the subject of the ends which we hope to attain through their use.

For purposes of discussion, we can agree that we shall place these objectives in order of their importance, as follows:

(1) Method of Study—planned to develop:

- (a) Independence of thinking and acting.
- (b) The habit of accuracy and exactitude.
- (c) The habit of suspended judgment.
- (d) The habit of perseverance and work.

(2) Informational content—presenting:

- (a) Science material which appeals to the student from the standpoint of present interests and needs (not necessarily vocational).
- (b) Material which is rich in general cultural values and opportunities.

- (c) Material, the character of which stimulates pupils to more purposeful activities.
- (d) Material which furnishes an opportunity to *develop* an appreciation of the privileges, duties and responsibilities of life in this age of rapidly developing science.

In the sciences which usually come later in the high school curriculum, such as Chemistry and Physics, I would place information content on a par with method, but I would not do so for the first course in Science which may come in the eighth or ninth year.

At all times in his school course, but particularly at this period of his training, am I anxious that my boy shall develop an independence in thinking which shall remain with him the remainder of his life. I care little what the teacher may believe concerning the tariff question or the tax question, if she provides a good opportunity for him to get the facts on these questions and reach his own conclusion concerning his beliefs. Science, being a truly non-partisan subject, quite free in this modern age from such prejudices as result from being born a Democrat or a Republican, lends itself particularly well to teaching which should result in independence in thinking.

The study of Science also should develop the habit of accuracy and the habit of suspended judgment. With the proper stress placed on these phases of his work, the pupil will soon learn that guessing is untrustworthy, and that there is a certain pleasure which comes from studying and working over a problem until he knows beyond any reasonable doubt that the statements he makes represent his best thought and judgment and express a sincere belief on his part which he is willing to defend. Such experience gives him confidence in his own powers, which will develop rapidly as the method of careful observation and reasoning to conclusions is practiced.

There is an intense satisfaction which comes from doing work resulting in some sort of worth-while knowledge or achievement, that is difficult to explain, but it is none the less real. The individual who never experiences the joy arising from the realization of having worked and of having achieved something worth while is indeed an object for sympathy.

The great thing that each individual is seeking is happiness,

which comes to him in proportion to the degree to which he has developed a philosophy of life that is sound and which can be satisfied by the attainments of the individual through a proper exercise and use of his powers. *Perseverance* and *work* are essential to such a realization, and our schoolroom methods should provide ample opportunity for practice in them.

Do not get the idea that young people do not like to work. They do, and in later years, as they refer to the teachers who have influenced them most, they will invariably place at the top of the list those teachers for whom they have worked hardest. It is time to emphasize the habit of work as one of the fundamental objectives of the public schools.

I have no sympathy with the idea that we must justify every part of a course of study by the measure of its utilitarian values. One of the fundamental characteristics of the human mind is that it desires to know things. We are innately curious. In this respect, we are very like our simian ancestors. If the information we acquire has an immediate use of somewhat practical nature, well and good, but it does not necessarily have to have this appeal to make it interesting and worth while. We may well spend considerable time in education with the study of subjects which broaden our vision and extend our horizons, even though the information gained never be put to a directly practical use. The only thing that is necessary to secure an interest for such material is that it be presented in such a way as to place the correct emphasis on the most fundamental of human experiences. This applies as well to the study of Science as to the study of History and English. There has probably been as much time wasted in the last few years in hunting for and teaching so-called practical problems as in any other way in which we waste time in education. Please do not understand that I am minimizing the value of problems in method. I know of no other device of modern education which has so many points of value. However, many teachers trained in other methods of teaching have tried to put all lessons into problem form, with many resulting disappointments. Not all the work should be put into this form. If, in the beginning of a teacher's experimentation with problems, occasionally a good one can be presented, the results will be most encouraging.

Since curiosity, as a characteristic trait, is so firmly fixed as a part of our natures, we shall always want to know a great many things; therefore, we shall be compelled to teach some facts. The progress, however, which we shall hope to make, will depend, not upon the facts, but upon the habits we develop in acquiring the facts, and upon the use that is made of the facts. Most facts are of very little value except as they enable a few of the people of the world to reason from them to conclusions of value to the world. These people are the Lincolns, the Roosevelts, the Steinmetz, the Edisons, the Fords, the Lloyd Georges and the Schwabs. We need many more of these people, so, of course, in our schools we should be placing the emphasis almost entirely on practice in the use of facts in developing the habit of reasoning through to a conclusion. Our instincts lead us to be curious as to what five plus five is today. We need that knowledge today and we can put it to good use. We may get a sense of satisfaction from knowing that five plus five was ten yesterday, but it is of infinitely more importance to know that it will be ten next week.

The fact that the science the pupil retains is a most valuable by-product and should be cared for accordingly, impresses upon us the value of well selected material from the great mass of material which exists. We say that the material should be selected from the standpoint of present interests. This does not mean that since the boy may be interested in radio sets at this time, that this subject should be stressed to the exclusion of others. It simply means that the material should be selected with due regard to the contacts that Science is making with the social and economic world in which our pupil lives.

The fine discriminations in values of the life about us come only through knowledge—knowledge of the arts and sciences. We are so constituted that we do get a great deal of pleasure from just knowing things. We want to see and experience the appreciation which others of our race have experienced in the ages that have passed. Therefore, we shall want to study the best in Art, Music, Science, Literature and Government for their cultural value. All subjects are cultural in the degree to which they develop appreciation of the value of the life about us and discover for us the power to understand and enjoy the beauty about us. The study of Science properly conducted

develops an appreciation of the service which it renders to humanity, an appreciation of the interdependence which exists in the social life about us, an appreciation of the slow but certain progress toward a better understanding of nature's plans, and an appreciation of the privileges and responsibilities involved in the life in which we live.

The material which we shall select for our course in first year Science, then, shall be determined by these questions:

1. Can it be presented so that it may be understood by pupils of the age of the group?
2. Does it permit of presentation in such a way as to bring out the best in methods of study for our pupils?
3. Does it touch the life interests of the pupil in such a way as to make it reasonably vital?
4. Does it have an appeal which can be justified from the standpoint of its cultural values?

When these questions can be answered in the affirmative, then there need be little doubt that the material chosen will be worth while. The report of the Commission on the Reorganization of Science in Secondary Schools, published in 1920, gives an excellent list of suggestions, including such topics as Combustion, Water, Air, Light, Work and Energy, Magnetism and Electricity, and Nature's Balance of Life.

In conclusion, it would seem that from the large amount of available material, the General Science teachers of any particular community should select the material for their course of study, varying the selection with the community in such a way as to appeal as strongly as possible to the interests of the pupils. I do not believe that any one course is suitable for all communities. We can probably agree that there are certain fundamental topics which should be included in all courses, such as the ones mentioned above. However, their treatment can be varied to relate them to the life of the community, with no loss in basic content and great gain in interest.

The demand for teachers of General Science should result in many more teachers taking up the work as their chosen field of teaching, and in the development, on the part of teacher-training institutions, of attractive courses in both content and methods. In my belief, the need for the subject of General Science exists and we are well on our way toward solutions of the problems which have arisen in the early years of its development.

The Use of Motion Pictures in Teaching General Science ¹

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MANY efforts have been made to redirect, enrich, and otherwise improve our courses in General Science. We constantly hear the argument made that everything should be presented in a practical way. Can we, by the use of motion pictures, teach General Science better than it has been taught in the past? Can we, by the use of films, better fulfill the recommendations given by the Committee on Reorganization of Science?

"The 'hearing of lessons,' memoriter repetition of facts and principles gleaned from the textbook, the more or less discontinuous dialogues between teacher and individual pupil should give place to a real class discussion in which all take an active part in contributing, organizing, and using the information dealt with. In such discussions the teacher serves to direct, stimulate and advise. There should be a maximum opportunity for self-expression in the immediate problems."

Many kinds of materials have been adapted to film presentation. Pictures illustrating manufacturing processes of real products, such as "The Making of Cotton Cloth," "The Making of Lumber," "The Manufacture of Steel." It would probably be impossible to present this material in any other form. It cannot be demonstrated in the laboratory with any degree of satisfaction, nor can a pupil really understand the significance of such processes by reading about them in books. If the material in these pictures is presented scientifically, it ought to be a great aid in developing broader concepts of the value of science in our industrial processes.

We have films presenting imaginary and synthetic processes, and films that give explanations of theories. "The Birth of the Earth," "The Origin of Coal," "How Life Begins," and "Beyond the Microscope," are some of the films that are used for these purposes. Many of these films are not entirely accurate, scientifically, nor do they agree with some of the modern conceptions of the nature of matter. There is a big field for

¹ Presented at the Chicago meeting of the Central Association of Science and Mathematics Teachers in December, 1922.

development here. These theories or processes cannot be demonstrated in the laboratory, nor can words give an accurate enough description of them for the boys and girls that are studying General Science. If we attempt to explain natural phenomena, we cannot proceed very far without the use of some theory. The only way to present these theories graphically is by use of the motion picture or pictograph.

Films in the field of geography and nature study, such as "The Yellowstone Park," "Thermopolis Hot Springs," "Birds and Animals," "Beautiful Flowers," present materials in a much more real and significant manner than can be done in any written description. In what ways can the wonders of nature be better presented than through the film?

Many of nature's processes are slow and tedious; the development and growth of plants requires a greater length of time than most classes in General Science can spare. But through the use of the film, these processes can be speeded up, so that the work of weeks or months required in the natural processes of development of plants, may be shown in a few minutes by the use of the film. No doubt there is danger here in removing too far the connection between the natural processes and the methods used by the film, but I believe this can be safely guarded against in the proper presentation of the material.

The historical development of machines, the evolution of some of our manufacturing processes, and the lives of our scientists, are fields that the film could develop, but which have not been done to any extent so far. "The Life of Edison and His Achievements," is one film that has presented this feature of science. The development of the steam engine, the telephone, the gas engine, different methods of keeping time, the development of the electromagnet, could be presented very graphically by the use of the film and the pictograph. If there is any one phase of General Science which we ought to emphasize more than any other, it is that of building in the pupil's mind the principle that there has been a general development in all types of machines—that no present-day machine was perfected at once. I do not know of any means so effective for demonstrating the development or changes in science as well as the film. What would be a better method of teaching than leaving with the pupil the possibilities that lie ahead in the

development of any of these machines? The new film on "Radio" tells us how to construct and set up a radio set, but it does not attempt to demonstrate what the radio might mean to us five or ten years from now.

There are many films in the field of chemistry and physics that could be adapted for use in General Science. Physical and chemical changes can be demonstrated in the laboratory quite satisfactorily, yet there are some aspects of these changes that can better be presented through the use of the film. "Crystallization," "How We Hear," "Formation of Dew," "Through Life's Windows," "The Smelting of Iron," are some of the films of this type. We can demonstrate the formation of crystals in the laboratory and the pupil can see that crystals have been formed; but does he understand just how these crystals were built up? The film can present this in a very realistic manner. Here the film aids in developing the concepts of crystallization by continuing the work initiated in the laboratory. How we hear, how we see, how we breathe, can be demonstrated in the laboratory, but the film can continue the work developed in the laboratory.

The film has far-reaching potential usefulness in geography, chemical and physical processes, development of theories, and in manufacturing processes. The physiographic features, wonders of nature, river systems, cities, modes of living, etc., are presented in the film with high skill and incalculable value. The entire series of processes involved in the production of any one of many substances created by the chemist, and the phenomenal side of all sort of revelations by other scientists, can be gripped up in a film and used either as a summarizing statement after study and experimentation, or as a projected picture antedating an interesting adventure into some of these enticing fields. In either situation the film can be used to tremendous educational advantage.

We need some new types of films in order properly to develop or continue the problems instigated in the laboratory or classroom. Many of our present films waste a large portion of their teaching value through the use of non-essential material--material that does not have any direct connection with the most valuable parts of the film. The films were made to amuse rather than to teach. The new types of films can be arranged

in three groups:

1. Films presenting situations to which pupils may react without so much information being furnished in the legends. Let the film ask questions.
2. Films of the problem-raising and problem-solving type.
3. Contrast films.

The ordinary film requires a mind that is receptive, passive, attentive—the mind that follows and approves. The new film will offer challenge, will give the mind data to work with, will develop a mind that projects itself ahead of the material in the film. There are practically no films of these types on the market. The most practical method of developing them is by having General Science teachers prepare the material for them.

In presenting situations in films to which pupils may react with out too much information being furnished in the legends, it may be interesting to know that "The Department of Visual Instruction" of the University of Wisconsin has prepared films with this object in view. They have taken a film on electromagnetism and divided it into six lessons, each lesson in a unit by itself. The original film was literally cut to pieces and the new lessons built up in a very methodical manner. New legends were made, more to direct the pupils' thinking than to give him a large number of facts. The material in each lesson was definite; it could be easily connected with the laboratory demonstrations and classroom discussions, thereby enriching our whole teaching procedure.

In the second type of new film—the problem-raising and problem-solving type—we can set up a problem, give the mind facts to work with, and then, by the use of these facts, solve the problem. We could raise the problem: What determines the power that can be developed by a dam? By the use of photographs and pictographs we could demonstrate how the height of the dam, the width of the dam, the distance the water is behind the dam, etc., might affect the amount of power developed by the dam. The pupils could solve the problem from the material presented in the film. There are scores of problems that could be solved by the use of the film. I simply mention the water-power problem because it is rather difficult

to demonstrate all phases of water pressure to classes in General Science.

In the third type of new film—the contrast film—it will be possible to present all of the data on both sides of any problem, and let the pupils decide for themselves what the correct solutions might be. We might, for example, develop a health program. On one side we could, by the use of photographs and pictographs, demonstrate the results of proper diets, good teeth, plenty of sleep, sufficient exercise, etc., while on the other side, we could demonstrate quite significantly the results of improper diet, lack of sleep, use of narcotics and stimulants, poor teeth, etc. From this array of facts, I am quite certain that pupils will not only arrive at more sane conclusions, but also their conclusions will become more permanent. The impressions created by the films will be more realistic to the pupils, and the conclusions reached will be more apt to become a part of their daily life, than if the same results had been obtained by reading a text-book or listening to the teacher telling them what not to do.

After having made a brief survey of the materials available for film presentation and having given recommendations for the new types of films, it is necessary to ask ourselves what technique shall be used in presenting these films.

The first consideration is the machine. There are many types on the market that are satisfactory. It ought to be possible to stop the machine quickly, reverse it easily, and to change the speed without too much difficulty. By stopping and reversing the machine, it makes it possible to get a reacting procedure and discussion from the pupils. To make the machine available for any teacher during any period of the day, it appears that the best plan is to train different pupils to run the machine during the different periods of the day. This gives the teacher abundant opportunity to direct the pupils in their discussions, while the mechanics of presenting the film is ably taken care of by the pupils.

The room for presenting the pictures should be darkened very easily. The room should be available during any period of the day, and the machine should be in such a position that it is always ready for use. The mechanics of presenting any film should require but very little time. The important thing

is presenting the film, not getting ready to present it.

There are several methods in preparing the class for the films. It is sufficient briefly to outline the different methods that might be used.

1. The film can be given without any previous discussion. This might be the introduction to a new problem.
2. The film can be given to continue some theoretical discussion initiated in laboratory or classroom discussions.
3. The film can be a summarization of a group of processes, or it can follow the completion of some study.
4. We can have pupils prepare questions for the film to answer, either as a prepared topic, or one in which broadcasted information is given.
5. The film can take the place of some experimental work in the laboratory. Students could draw their conclusions from the facts presented in the films.

The types of films are important. The methods of presenting films are also important. But the most important factor in all of these is: What are the pupils doing while the film is being presented? The criticism against the motion picture on the ground that visual instruction makes no demand upon the audience to do any creative thinking is an indictment that may be lodged against other objective representations of reality. The printed page is too often viewed with a high degree of passivity. The reader may be the victim of the dogma of acceptance, merely following the printed page with as little productive thinking as the person who follows the film presentation. The issue in all these situations is this: Does the individual behave as a recipient or a reacting agent? Is he a spectator or a participant?

The film should not necessarily aim to amuse the pupils nor should it give the impression that this is a day when no work is to be done. What can the teacher do to create the impression that the presentation of a film carries with it the notion that facts are to be gained, problems are to be solved, conclusions are to be drawn, and applications are to be made?

Several different methods can be used to develop a reacting procedure in a class while the film is being presented. These given in outline form are:

1. Groups of pupils can prepare talks or lectures on the film. This is one method of distributing the work among the different members of the class.
2. Questions can be raised by the different members of the class and a general discussion might follow. The film could be stopped to make sure that all data are in hand.
3. The film can be stopped in order to have the mind anticipate what might follow. This will get attention forward.
4. Part of a film may be shown and then ask the class to consider what the remainder of the film might hold in store for them. In experimenting with a film on "The Yellowstone Park," after about half of the film had been presented, the pupils were asked to write what they thought the remainder of the film contained. They obtained all of the information they could from different sources. The next day when the remainder of the film was shown, the pupils were surprised to find what they considered the most interesting features of the park were not even presented in the film. This gives the pupils an opportunity to judge the value of the material presented in any films.
5. Pupils should be given the opportunity to question the accuracy of the film and the relative importance of the material presented. Many times it will be necessary to re-run parts of the film, to be sure all data are in hand.
6. Some teachers ask the pupils to take notes on the films. I doubt very much if this has any great value. It is difficult to take notes and watch the picture at the same time, on account of poor illumination in the room.
7. If the legends in the film do not give too much information, we can ask the pupils to tell what the picture seeks to present. The film can be stopped frequently and a comparison of results made. Let the pupils develop a story or theory from the material presented without any information being furnished in the legends. This creates a great deal of interest among the pupils. It is also a basis for much valuable discussion.
8. Pupils can make lists of problems suggested by the films that have correlation with other studies. Many times some scientific facts will have a direct bearing on some

phase of English, History, or Mathematics. Occasionally teachers from different departments could group their classes for the presentation of a film.

Thus we see that there are many methods of having the pupils react to the material in the films. Different types of pictures will require different methods, but there isn't any reason why we cannot teach pupils to think while they are seeing the pictures.

After the actual running of the film has been completed, we must ask ourselves: What can we do to continue the work that has begun?

1. We can give a written or oral examination to the pupils, testing them for the facts and principles presented.
2. We can test the pupils for the theories presented. The theory should be developed in a logical order.
3. We can ask the pupils to schematize the problem as presented.
4. If the film did not present its material logically, or some of the pupils did not understand the principles developed, we could have each one of the pupils ask a few questions on the film. This would be an excellent method of humanizing it.
5. We could have the pupils test the accuracy of the film. This could be done by comparing the material presented in the film with facts as developed in the laboratory, classroom discussion, or in reading books.
6. The film could be made the basis for a written summary. This would be an excellent opportunity to correlate the work of the science and English departments. The teacher of English might have some of his classes see the pictures with the general science classes.
7. The pupils could be asked to compare the film presentation with the linguistic presentation. Which presents its material more clearly?
8. In the problem-raising and problem-solving type of film, the pupils could begin the advanced study of the problem. The film would be only the beginning. The pupils would find it necessary to use other means to continue the study of the problem.

9. In the contrast type of film it will be necessary to have some discussion after the film has been presented. Each pupil should have an opportunity to present his conclusions to the class and have them give their judgment of the accuracy of the conclusions. Occasionally it would be necessary to have the pupils seek further information before attempting to make their conclusions.

No matter what method we use during or following the presentation of a film, the pupils should not get the impression that any film in itself is self-sufficient. A good film should always require further study of some kind. A film that simply attempts to amuse, or presents its material in a haphazard way, is out of place in the classroom.

It is unfortunate that so few studies of the educational value of the film have been made. What are the experimental aspects or possibilities of the film? The argument we most often hear is that the film is a time-saving device. In what way is the film a time-saving device? If we let pupils see motion pictures for a certain length of time, and then have them make a record of the facts that they have gained, and compare these results with what pupils can do by reading and discussion for the same length of time, we will find that there is very little difference in the amount of information gained by the two different methods. However, the results vary greatly with different individuals and with different types of work. The poorer pupils seem to do much better in seeing the film than they do in reading a book. This may be one method of speeding up the poorer pupils to a realization of their responsibility. If we test these same pupils for the same facts some time later, we find that the film seems to have made a more permanent impression. In other words, pupils remember facts better by "seeing" them than by reading about them. This, in itself, probably substantiates the argument that the film is a time-saving device.

Many types of problems can be presented by the use of the film in a much shorter time than they can be demonstrated in the laboratory. There is a film on the telephone that presents most of the facts in less than ten minutes. It presents all of the facts and principles that are ordinarily demonstrated in the laboratory. Very little demonstration could be done in

the laboratory in less than one hour. Even though we have saved time, we ought to question ourselves as to whether a pupil would gain as much by seeing the film demonstration of the telephone as he would by actually handling the apparatus and materials he uses in the laboratory. As far as I know, no one has worked out this problem. We could make the same argument for the gas engine. The film presents very thoroughly all the principles involved in the operation of a gas engine in less than 30 minutes. We could do very little with the gas engine in the laboratory or classroom in the same length of time. It would be an interesting problem to decide what value each method has.

Another method of saving time would be to join different classes in general science, or other classes in science. Some types of films could be presented to large groups as well as small groups. Then again, classes in general science and English could meet together. The science film might be made the basis for their compositions or themes. By seeing the film the English teacher could judge of the accuracy of the statements made in the compositions or themes. Classes in science and history could be grouped in the same way. The development of modern industrialism would be an excellent opportunity for the correlation of the work in the two departments.

An experiment was conducted at the University of Wisconsin on the use of the film in teaching facts and principles, as compared with the ability of an experienced teacher and an inexperienced teacher to teach the same facts and principles in the same length of time. Sixty pupils were divided into three groups of supposedly equal abilities. The divisions were based on the scholastic standings of the different pupils. The two teachers saw the presentation of the film and were also given an outline containing all of the material presented in the film. The teachers were given ample time to prepare their material for teaching their classes. The teachers could use any method they desired in teaching their classes. On the same day the three groups assembled in their respective rooms. The film, the experienced teacher and the inexperienced teacher, all three, *taught* the best they could for one hour. At the end of the allotted time, the three groups met in the same room, and were given an examination covering the facts presented in the film.

The results obtained by the inexperienced teacher were much lower than those obtained by the film, while the results obtained by the experienced teacher were slightly higher than the film. It would be dangerous to jump to hasty conclusions. When the same methods were used on different groups, the results varied considerably. However, it seems to prove that the film can teach facts and develop principles as well as a poor teacher, but no one would maintain that the film ought to take the place of the teacher. Their purposes are entirely different.

In brief, the film can be used in the motivation and enrichment of ideas; it can be used in the promotion of creative thinking; it can arouse curiosity and it can develop the work spirit. The thing of most value in the film is its use in tying up different techniques of teaching. The laboratory work, the reading of the text book, class discussions, questions and problems, can all be taught with more interest to teacher and pupil, if teaching and learning are supplemented occasionally with good films.

The Vitamins and the Vitamin Bunk¹

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SINCE presenting this subject before the Northeastern Section of the American Chemical Society last season, there has been but little change in the potency of the vitamins; but considerable has been added to the "bunk."

I have no desire or intention of criticising the scientific work which has resulted in the discovery of those wonderful unknown substances called vitamins; but I wish to point out certain abuses of these discoveries which have been made by commercial houses, and the relation of these abuses to our food and drug laws and our false advertising law.

Let us first consider the vitamins historically, biologically and chemically, apart from the bunk. As early as 1870 Kramer stated, regarding scurvy: "If you can get green vegetables; if you can prepare a sufficient quantity of fresh antiscorbutic

¹ Presented before the Science Section of the New England Association of Colleges and Secondary Schools, December 9, 1922.

juices, if you have oranges, lemons, citrons, or their pulp and juice preserved with whey in a cask, so that you can make a lemonade, or rather give to the quantity of three or four ounces of their juice in whey, you will, without other assistance, cure this dreadful evil."

In 1896, Hopkins, an Englishman, concluded that animals required something in their foods other than the common nutrients, and called these hypothetical substances, "accessory food factors."

In 1898, Eijkman, a Dutch chemist, succeeded in producing in fowls a disease called polyneuritis, which is substantially beriberi, by feeding polished rice, and was able to cure the disease by feeding rice polishings.

In 1907 Fraser and Stanton showed that an alcoholic extract of rice polishings contained the curative for beriberi.

In 1909 Stepp, a German, discovered that if bread and milk was extracted with alcohol-ether the residue was unsuitable for growth, and that the addition of purified fats did not supply the deficiency. He discovered that the addition of the substance left after the evaporation of the alcohol-ether extract was capable of promoting growth.

In 1909 and 1910 Osborn and Mendel showed that in rat-feeding experiments, no matter how efficient the diet was, the rats refused to grow unless there was added to the diet a factor found in milk. They also discovered that the factor was found in two fractions, namely, in the fat and protein free milk, and that the absence of either fraction would prevent growth.

In 1911 Casimir Funk obtained by chemical fractioning of extracts of rice polishings a crystalline substance, highly curative for the disease beriberi, and a year later obtained this substance from brewer's yeast. This substance contained nitrogen in its basic form, and, since it is essential to life, he gave it the name "vitamine." Subsequently it was discovered that the dietary essential was an impurity in the crystals, which has resulted in considerable discussion regarding the validity of the name "vitamine."

About the time that Funk published his findings and named the product, Suzuki, a Japanese, and his fellow workers Odake and Shimamura, isolated a curative substance from rice polish-

ings, which they called "oryzanin."

Dietary studies made in the Wisconsin Agricultural Experiment Station, under suggestions from Prof. S. M. Babcock, showed that animals nourished by the same amount of proteins, fats and carbo-hydrates were not furnished with sufficient bodily needs in all cases. These experiments were reviewed and continued by McCollum, who, in 1912, announced the "unidentified dietary factor fat-soluble A," found in milk fat and egg fat.

Notwithstanding the fact that at least one of the vitamins is not an amine, and the evidence of the amino nature of another is far from satisfactory, the name "vitamin" is here to stay, and at present we believe there are at least three,—the fat-soluble "A," the water-soluble "B," and the antiscorbutic "C," and, possibly, the antirachitic "D," with indications that we have not yet reached the limit. They are all of vegetable origin, and their presence in animal foods, as in milk, depends upon the character of the food eaten by the animal. We know practically nothing of the chemical nature of these substances, except considerable of what they are not.

The testing of vitamins is done by time-consuming and, to some extent, unsatisfactory biological methods. Animals are fed upon diets otherwise sufficient, but deficient in the specific vitamin to be tested for. When the animal shows by lack of weight or other physiological abnormality that it is suffering from the dietary deficiency disease, there is added to the diet the substance to be tested, and the animal recovers if the specific vitamin is present.

The study of vitamins is of primary importance to the dietitian, to the infant specialist, and to the physician dealing with certain diseases, but its interest to the public is due to the mysterious nature of the substances. The human race has managed to survive for a few generations, depending upon its appetite in the selection of its food, and, except in certain instances of famine, etc., a knowledge of the vitamins would have had little or no beneficial effect upon the race, broadly speaking. Nature works in a horribly ruthless manner, but man has always been making more or less effort to improve conditions for the weak and downtrodden; consequently, the general average condition of the human race is somewhat

inferior physically to that of the wild animals, and more care is necessary in selecting our diets.

The articles of food most liable to contain no vitamins are purified chemicals, such as starch, sugar, vegetable oils, "purified" flour, etc. The articles of food containing all three vitamins simultaneously—the "A," "B" and "C"—include raw milk, liver, germinated grains, cabbage, tomatoes, beet roots, carrots, cauliflower, lettuce and spinach. In addition, apples, bananas, eggs, peas, string beans, white potatoes (raw), and fish roe also contain the A, B, C vitamins, but in smaller quantities. Most other foods contain one or more vitamins, and it may be stated, as a general principle, that given a sufficiently miscellaneous assortment of foods to choose from there will be no dietary deficiency diseases.

Vitamin "A" is comparatively stable to heat alone, but in the presence of oxygen it is rapidly destroyed by heat. Hydrogenation destroys it, but acids and alkalis have but little effect. Butter, milk, spinach, alfalfa, and codliver oil are high in vitamin "A."

Vitamin "B" in acid or neutral solutions is fairly stable to heat, but in alkaline solutions it can be quickly destroyed at 90° C. Alfalfa, beans, yeast, spinach, cabbage, tomatoes, and wheat middlings are high in vitamin "B."

Vitamin "C" is much more sensitive to heat and alkali than the others. Temperatures above 50° C. are more or less destructive, according to the time factor. Cabbage cooked one hour at a temperature between 80° and 100° C. loses 90 per cent of its antiscorbutic properties. Sprouted grains, citrus fruit juice, raspberries, tomatoes, cabbage, lettuce, rutabagas, and raw onions are high in vitamin "C."

If an apple a day will keep the doctor away, what will not an onion a day do? It will keep not only scurvy, but the doctor and everybody else away.

A recent speculation as to the nature of the vitamins was published in the Boston Transcript, June 27, 1922, quoting experiments by Dr. Benjamin Harrow on germinating corn, indicating that either the vitamins are produced by the sun as chlorophyll, or that the production of vitamins depends on chlorophyll. The codliver seems to be the exception to this rule, but the cod is a scavenger more or less.

As research work upon vitamins progresses we increase our list of foods found to contain them.

The "bunk" is based on the credulity of human nature. The original witch doctor, with his charms to scare away the evil spirits, was one of the earliest persons to produce and disseminate bunk, and his methods have been adopted by his logical successors, the purveyors of the vitamin "bunk."

The belief in the supernatural is even now highly prevalent, and appeals to that belief usually bring results, other things being equal. The peculiarly mysterious properties of the vitamins have popularized them, and they have been swallowed hook, line, bob and sinker, by the public. It is worthy of note that the same procedure ensued relative to electricity, radium, and the Einstein theory. Thirty years ago electric belts, electric inner soles for shoes, electric batteries, etc., were quite commonly used for the mitigation of real and imaginary diseases, while thirty years after we accomplish better results with electric coffee-pots and electric washing-machines. Radium was not very popular as a general cure-all, possibly owing to the expense, and the Einstein theory is not adaptable. The vitamins, however, are so constituted that they can and are being sold at high prices to the credulous, to mitigate mostly imaginary evils.

I believe that the continued sale of the products is doomed to failure for purely psychological reasons. A proprietary medicine, to be successful, must possess two prime attributes: first, it must have a disagreeable taste or odor, and second, it must show immediate physiological results. The vitamins must of necessity fail in these attributes, unless, as in some instances, drugs are added, because they are tasteless and because the abundance of vitamins in our daily diets is such that preparations containing these agents would have no visible effect. These commercial preparations are essentially yeast or other vegetable concentrates, and to some are added strychnine, phenolphthalein and organic iron compounds to secure the physiological results so necessary for the commercial success of a proprietary remedy.

No person takes more care in his advertising than the proprietary medicine man. He knows the laws, their limitations, the efficiency of enforcement, and knows that outside of food

and drug advertisements there is little or no systematic policing of false advertisements. He is, therefore, careful, and the vitamin bunk shows efficiency in complying with the food, drug and advertising laws. Let us consider the bunk:

Weigh Yourself—Then Take Vitamine Tablets—and watch the results. Thin, weak, run-down folks who wish to put on Good Firm Flesh, etc., should try this wonderful nutrition product.

The advertisement shows a female figure tipping the scales at 95, with scrawny neck, ungainly figure, flabby tissues and sallow complexion. Facing her is the figure of a buxom female of 125 pounds, with clear skin, firm flesh, and well-rounded figure, chock full of vitamins.

The advertisement states:

We do not claim, however, that vitamins will put flesh on everybody. Some people are naturally too thin and will probably remain so in spite of vitamins and everything else.

This advertisement advises obtaining your strychnine from other sources.

Another advertisement of the same proprietary calls attention to a startling exposure, and picturing a young lady in an abbreviated costume, truthfully states:

Take one single substance from the blood of the beautiful, healthy, well-formed woman in this picture, and she will become weak, thin, emaciated, like the thin, scrawny woman in the picture below, on three or even four meals a day—put this magic-like substance back and she will quickly put on good, firm flesh and become rosy-cheeked, strong and vigorous, even on two meals a day.

It again calls attention to the fact that the preparation does not always work, but neglects to add that our daily diet usually contains this one single substance so necessary for our continued existence.

A description of a different product shows two female figures of different weight, appearance and dimensions, the inference being that vitamins did it.

The directions are to first weigh and then measure yourself, then take two tablets with each meal and keep up the process until you are satisfied with your gain in weight and energy. Note the complete absence of the time factor. The gain in energy is insured by the addition of strychnine to the tablets.

Another advertisement of the same drug is similarly worded. Just above the picture of the young lady chock full of vitamins, pep and strychnine are directions to take some tablets and watch the surprising results. Does this possibly refer to an overdose of strychnine? I hope not. There was one death in this state last year due to too many strychnine tablets in a child.

An advertisement referring to a yeast tablet contains one false statement. Referring to iron and vitamins it says, "Both of these elements are lacking in the average modern diet." They guarantee to "bring satisfactory results or your money back." The proviso covers a multitude of sins.

Certain definite measurements of a young lady are given in another advertisement. In twenty-two days she increases in weight 10 per cent, chest 8.6 per cent, calf 8.3 per cent, arm 5.3 per cent, neck 4.1 per cent. There is still room for improvement. She will be heavier when she reaches the age of forty.

Let us lay aside the "bunk" for a few moments, and consider some facts. McCollam and Simonds report in the *Journal American Medical Society*, Vol. 78, p. 1293, some results of the examination of one of the above mentioned proprietaries. They fed rats on a basal diet for five weeks, when vitamin B deficiency was noted; then the vitamin tablets were added in quantity recommended for adult humans. The animals grew weaker during this period of four weeks and lost weight. Four per cent of wheat germ was then added to the diet; the animals immediately responded to the treatment and normal growth occurred. Similar results were obtained with 20 times the amount recommended for humans. The investigators conclude that this proprietary does not contain any more than mere traces of water-soluble B and is very inferior to most of our ordinary foods in its content of this substance. A publication from the Connecticut Agricultural Experiment Station, Bulletin 240, just issued, discusses some tests made on these commercial preparations, and while the results do not indicate an almost total absence of vitamin, as did McCollum's, yet many of them were sadly deficient in vitamin B.

An editorial in *Standard Remedies*, August, 1922, infers that the vitamin bunk is not confined exclusively to the proprietary medicine manufacturers. It states: "The New York Times

discussing the expectation (probably meaning exploitation) of vitamin products, mistakenly refers to the patent medicine business as moribund. It is far from that. There are more proprietary medicines being manufactured and sold in the United States today than ever before—and to morrow will break today's record. Take patent medicines out of the drug store, and not only would the public be injured, but the drug store would, in many instances, be obliged to close. We don't know about the merit of the vitamin products. We are not alone in our ignorance either. The political doctors, whose purpose in life is to decry anything which doesn't drive people to them, or which keeps dollars away from them, share it. They don't know, but they like to say that the vitamin products produce no effect that cannot be obtained from a well balanced diet of common food. Well balanced diets are rare; most men eat poor cooking, and few women know how to prepare a 'balanced ration.' Therefore, if the vitamin product can produce this effect of a well balanced ration, we'll say that they are worth while."

I am inclined to question the accuracy of the statements that most men eat poor cooking, and that few women know how to prepare a balanced ration.

This editorial also states that proprietaries "are being prescribed more frequently than ever before by physicians, and by many physicians of outstanding reputation."

An interesting advertisement, designed by a man who recognizes the bunk and takes the bull by the horns, says:

The discovery and scientific application of the elementary units of body-building foods are wonderful helps in rebuilding the ailing. The average person who has robust health and strength does not worry about vitamins and calories; he simply uses ——— appetizing and high in food value.

To attract attention, this advertisement is headed, "Vitamines and Calories."

In the Boston Herald and Boston Transcript of November 6, 1922, will be found a news item pertaining to the discovery of a means of preparing a vitamin syrup to mix with bread, in order to obtain a high vitamin content in bread made from white flour. This piece of research was performed with funds provided by the Ward Baking Co. The article in the Transcript was headed:

"SCIENTISTS TRAP VITAMINS."

This may not be bunk, but it is the forerunner of bunk to come. The bakers are trying to discourage the production of home-made bread, and we may soon expect to see advertisements stating:

"If you want a slow death, eat home-baked bread. If you wish to be filled with vitamins, eat factory-made bread. We have corralled the vitamins, have trained them, and control the process for so doing. Do not be fooled into using inferior substitutes."

Soon after I had written the above, the advertisement was brought to my attention. I at once wrote to the company issuing it, and suggested that it be toned down a little. This bread is made by adding wheat germ and wheat bran extract as well as considerable whole milk to the white flour. It is evident that a person can live upon this mixture, but who cares to do so. The article may sustain life, but does it make life sustainable?

One advertisement, strictly in accordance with the facts, is nevertheless misleading to those who do not understand the situation. It shows a chart the abscissae of which represent time and the ordinates represent weights of animals, presumably rats. One curve representing the vitovim bread travels upward at an angle of 59° . That representing animals fed on three popular white breads declines until vitovim is added, and then it increases at an angle of 45° . The inference that will be drawn from this chart is that ordinary white bread has no nutritional value, whereas the reverse is the case. You pay a little more for this brand of bread, but you get some very interesting advertising for the added cost.

The discovery of the "A" vitamin has given a tremendous stimulus to advertisements concerning the dairy interests. The per capita consumption of milk and butter has materially decreased since 1916, but is now increasing, due to reductions in price rather than to the publicity. The general public prefers butter to oleo, but when the prices go too high the consumption of oleo always increases, and with falling prices it decreases. With increasing milk prices the consumption is curtailed, and with decreasing prices the consumption is increased. The advertising of milk as a food, with reference to its vitamin content, is in general accordance with the facts,

except that no mention is made of low or no vitamin milk, which is something more than a scientific curiosity.

One milk advertisement is rather peculiarly worded. The originator thereof believes that without vitamins we would only half exist, when, in fact, we would cease to exist.

An advertisement regarding a certain brand of oleo is not false, but is peculiar from a business viewpoint. It calls attention to the high quality of the oleo because of the high vitamin content of the milk used in its manufacture. A strict interpretation of this advertisement would be construed as advice to eat butter. Oleomargarine has reached the point where it can stand upon its own merits, and need not depend upon its slight association with the dairy industry to make its sales effective.

There has recently been put on the market an article consisting of condensed skimmed milk emulsified with cocoanut oil. It is devoid of vitamin "A," is sold for what it is, and is labeled, "Do not use for infant feeding," and saves considerable skimmed milk which otherwise would go into the sewers. An attempt is being made to prevent the interstate shipment of this article by congressional action, for the purpose of saving the lives of children who would be given the article for food. The proponents of this measure do not consider that a mother who would feed her child an improper diet in one respect would continue to select improper diets if one objectionable substance were removed. It would be disastrous to adults if only infant foods were permitted access to our markets.

The yeast fad is peculiar. Yeast is high in vitamin "B," but why eat yeast cakes when so much more palatable foods containing the same substance in abundance are readily available. It has been fairly well established that yeast can synthesise vitamin "B" while growing in solutions of purified nutrients. See Margaret B. MacDonald, *Journal Biological Chemistry*, Oct. 1922, p. 243, who states: "There can be no doubt that the rats in this test received a supply of water-soluble vitamin 'B' during period 2 . . . and the vitamin 'B' this yeast contained was synthesised by the yeast cells. The results obtained by feeding five varieties of yeast amplifies the findings of Nelson, Fulmer and Cessna (*Journal Biological Chemistry*, 1921, XLVI, 77) and make general their conclu-

sions for one variety of yeast." We may, therefore, assume that if a yeast cake is planted into some dough made from white flour, there will be more than one yeast cake in the finished product and possibly more vitamin "B" than at the beginning of the operation. On the contrary, Kennedy and Palmer, in the same issue of the Journal of Biological Chemistry, p. 237, state: "Our results do not support the general belief that yeast is an unusually valuable source of the growth promoting vitamin B, or that it can be accepted as a standard product in experiments in which a vitamin B preparation is required."

A recent yeast advertisement quotes a diet including boiled potatoes and buttered peas, claiming deficiency unless yeast is added. Unfortunately the paper carrying the advertisement is published in another state, and our laws are not applicable under such conditions. Another states, "They pay heavily for it in later life," but it also could say, "They pay heavily for it now." And still another says, "Add two or three cakes to your own daily diet and note the difference," which statement could readily refer to increased cost of your meals. The statements regarding the vitamin "B" content of yeast are substantially correct, but the insinuations that the general public is subsisting upon a low or vitamin-free diet are incorrect.

Commercial yeast contains about 55 per cent starch and 25 per cent water, and is sold at \$1.43 per pound. The protein content is about 6 per cent. If the starch is deducted at 8 cents per pound, we are paying \$3.09 per pound for an article containing 13.3 per cent protein, with a fuel value of 284 calories per pound, or at the rate of \$12.45 per 1,000 calories. Steak cod, 16.7 per cent protein, 0.3 per cent fat, 325 calories per pound, at 15 cents per pound costs \$1.96 per 1,000 calories. Turkey at 65 cents per pound, 21.1 per cent protein, 22.9 per cent fat, allowing 25 cents per pound for the fat value, will cost, fat free, 76 cents per pound for 27.4 per cent protein and 511 calories per pound, or \$1.49 per 1,000 calories. Spinach, strictly a nutritional and dietary food, consumed largely for its vitamin content, at 25 cents per peck or 8 cents per pound, will cost \$2 per 1,000 calories of protein. Yeast is an expensive food.

One cannot grow fat on vitamins alone, neither can one do any work on vitamins alone, but in addition one needs some

fat, some carbohydrates, a variety of proteins and mineral substances. A deficiency of any of these will produce serious pathological disturbances which require the services of the skilled dietitian, who can make a proper diagnosis of the trouble, rather than those of the proprietary medicine man, who does not know you or your trouble. The popular application of the vitamins is to eat three square meals a day and do not worry.

This was well expressed by Dr. H. W. Wiley at the 1920 meeting of the Association of Official Agricultural Chemists, as follows:

Milk and greens have Vitamins
Enough for little Sid,
So he, at least, will need no yeast,—
A real self-raising kid.

The Safety of Shallow Wells

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One of the topics which teachers of General Science should emphasize more is the great likelihood of contamination of shallow wells. Today, in spite of the fact that all cities and many towns provide their citizens with safe water, the problem is nevertheless of great interest to the city dwellers. On automobile trips most Americans are tempted at one time or another to drink water from shallow wells. Being accustomed to safe water, they often are thoughtless of the danger. Hence city dwellers as well as rural dwellers should know more concerning the safety of wells.

Probably a majority of the several million wells in America are unsafe. While any given well may never have been contaminated, it is probably so situated that contamination may occur at any time. The magnitude of the danger is suggested by the terrible loss of life from typhoid. An average of 15.5 persons per 100,000 in the registration area of the United States died from typhoid in the years 1910-1919. Most typhoid is traceable to impure water, either drinking water or water used to wash milk containers. Although the safe thing to do is to be inoculated against typhoid, the following brief statements may

prove of assistance in making effective the discussion of the dangers from shallow wells:

I. Facts essential to an understanding of the safety of well water:

1. The water obtained from all wells entered the ground from the surface.
2. Water may carry disease germs; indeed, very often does. Typhoid, paratyphoid and typhus fevers, and several rarer diseases, are transmitted thus.
3. Water which filters through about 50 feet of clay or 200 feet of sand is purified, the movement taking too long for the germs to remain alive. The amount of filtration required depends upon the porosity of the clay or sand and the size and virulence of the germs. These figures are conservative.
4. However, water may move much greater distances through openings in limestones and through cracked rocks of all kinds without being purified.

II. How can one observe whether or not the well is probably safe?

1. See if the top and sides of the well are tight. Of course, if water can enter the well from the top through cracks in the boards, for example, or around the sides of the well near the top, it may easily be contaminated.
2. If there are openings in the casing of the well above the level of the water, it may be unsafe, for contaminated water may have soaked through the soil and entered the sides of the well without having been sufficiently filtered.
3. There should be no opening around the outside of the casing, for a watertight pipe will not insure safety if water can trickle down to the well outside the pipe. Hence, as soon as the casing has been put in a well, clay should be packed tightly into any opening which there may be between the casing and the earth.
4. If the well is not 50 feet deep in clay, or 200 feet in sand, it may be unsafe, in spite of having a watertight top and sides all the way down to the water level, for

dirty water may soak down to that level a few feet from the well, and thence flow into the well. Hence wells of less than these depths should be sufficiently remote from sources of contamination so that no water can reach the well without being filtered through 50 feet of clay or 200 feet of sand. If the well is on a small hill, or mound of clay, the prospects of contamination will be reduced, since surface water will flow away from, not toward the well. A mound of sand or gravel does little good, because gravel and sand are quite porous.

The difficulties of making a well, situated below a source of contamination, safe, are so great that such wells should be carefully avoided. Most wells in the country are used chiefly for watering livestock. The chief prerequisite in such wells is the abundance and convenience of the water. It would be desirable if wells for human use alone were more common. Such wells would not need to supply large quantities of water. Hence wells made by driving an iron pipe deep in the ground, far beneath the top of the permanent water supply, usually would suffice, and thus could be located, if necessary, at considerable distances from conspicuous sources of contamination, the water being piped to the house.

Another point merits a few remarks. Because some farmer has drunk the water of a certain well all his life without being sick a day of his life, does not insure the safety of a poorly constructed well. If water can easily enter the well from above, as often is the case, it may have been contaminated by the last guest at the well. It is known that many hoboos and tramps and a considerable number of respectable persons are "typhoid carriers," having the disease themselves in mild form only, but capable of giving it to others in virulent form.

If we teachers point out the many sources of danger from shallow wells, it will lead to an avoidance of bad wells, to the construction of better wells, and to more widespread inoculations against typhoid. The experiences with typhoid during the Great War proved that such inoculation was fully effective for several months or longer, usually for three or more years.

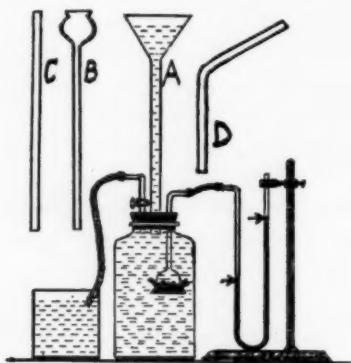
Pascal's Law

JOHN C. PACKARD, High School, Brookline, Massachusetts.

THE apparatus shown in the figure can readily be assembled from materials to be found in most General Science laboratories. The inverted thistle-tube, covered with a rubber membrane, and connected by a bit of rubber tubing with the U-tube manometer, is used to show changes of pressure inside the flask.

Water Pressure.

Starting with the apparatus empty, and the stop-cock in the outlet tube open, pour water steadily in through the funnel (A) and observe the effect as shown by the manometer. Conclusion? When the water has risen to the under side of the stopper, close the stop-cock and resume the pouring-in process. Observe the effect as the funnel itself begins to fill. Open the stop-cock and observe what happens as the water falls. What effect, if



any, is produced by a change in the *diameter* of the water-pipe? Remove the funnel (A) and substitute, first, a thistle-tube (B), and second, a straight piece of tubing (C). Record the manometer reading in each case when the water stands at the highest level. The pressure at any given point in a liquid depends upon what?

Air Pressure.

Substitute a glass tube (D) for (A). Have the bottle three-quarters full of water. Close the stop-cock and force air steadily into the flask above the water. Observation? Conclusion?

How are objects at the bottom of the ocean affected by the pressure of the (1) overlying water, and (2) the atmosphere resting upon the surface of the ocean?

Cooperative Work in the Organization of Local Material for General Science Instruction: Water Supply Systems. (Continued)

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OUTLINE.

- I. Introduction.
- II. Part 1. The Oakland, California, Water Supply System.
- III. Part 2. The Water Supply System of Cleveland, Ohio.
- IV. Part 3. The Water Supply System of Muskogee, Oklahoma.
- V. Part 4. The Cincinnati Water Supply System.
- VI. Part 5. The New York Water Supply System.

Part IV. The Cincinnati Water Supply System.

Lesson I. The Importance of Water to Life.

a. Introduction.

Reading assignment, Van Buskirk and Smith, "The Science of Everyday Life," pp. 68-69.

Enumeration of uses of water by the class.

- b. Outline of an excursion for the purpose of studying water sources.

Lesson II. The Sources of Water.

- a. An excursion to a nearby hill overlooking the conjunction of the Millcreek and Ohio River valleys.

Purpose: To learn how water gathers together to form streams, and how it receives its impurities.

OUTLINE FOR OBSERVATIONS.

The valley running south was made by The valley running west was made by

Two kinds of rock compose this hillside. They are and dissolves in soil water. On top of the hill the rock is covered with When rain falls on the soil it It continues to seep down through the rocks, until it is stopped by Then it runs and may finally come out on a hillside. This makes a The water then runs down into the valley and becomes a part of, and then a part of the It carries with it, which dissolved in it from the underground, and, which it picked up as it flowed down the hill.

Millcreek Valley extends for miles through the city, and on its banks are many, as well as It may therefore contains and

Along the Ohio River and its tributaries, above Cincinnati, are towns, which empty their into the river.

All of these things make the river

(Note: Samples of water are to be brought back from the stream on the hill.)

- b. Reading references van Buskirk and Smith, pp. 78-79; Caldwell and Eikenberry, "General Science," pp. 159 to 162; Hodgdon, "Elementary General Science," pp. 276-285; Hessler, "First Year Science," pp. 78 and 121.

Lesson III. Impurities in Natural Water, and How They Get There.

Review of the excursion outline in the light of the information gained from reference readings.

Lesson IV. Testing Water for Impurities.

- a. Boil dry a sample of raw water in a test tube, and note the deposit.
- b. In the sunlight, and under a microscope, compare samples of raw water with "treated" water.
- c. Test raw water and treated water with potassium permanganate for impurities.

- d. Begin a labelled collection, in bottles, of water samples. Individual assignments: Bring samples of water to class from—

(A) Ohio River, and (B) Millcreek.

Reports on the early history of the Cincinnati water supply: C. 1799-1821; D. 1824-1839; E. 1845-1865; F. 1866-1880; G. 1881-1907. Reference: "Report of the Water Works of Cincinnati for 1919, 1920, 1921," pp. 13 and 14.

Lesson V. The Early History of The Cincinnati Water Supply.

- a. Reports as assigned in the preceding lesson, using pictures from the official reports and other sources.
- b. Assignment:
 - A. Brief notes are recorded in pupils note books on information obtained from the reports.
 - B. Read: "How Water May be Purified," Van Buskirk and Smith, pp. 80, 81; Caldwell and Eikenberry, pp. 163, 165.

Lesson VI. How Impure Water Can Be Purified.

Demonstration by pupil or teacher of:

- a. Filtration with a sand filter built up on the plan of those used in practice.
- b. Coagulation and settling with lime and iron sulphate.
- c. Distillation. Each demonstration is described in the pupil's note book together with conclusions as to which methods are practical for cleaning city water, and what types of impurities are removed by each process.
- d. Assignment of group reports:
 - 1. Taking the water from the river.
 - 2. Purifying the water.
 - 3. Distributing the water to the pumping stations.
 - 4. Distributing the water to the hills.
 - 5. Consumption of water.

Reference: A typewritten description furnished by the Cincinnati Water Works Department.

Lesson VII. Our Modern Water Supply System.

- a. Discussion of the Water Works system, preliminary to an excursion. Locate the plant on a map of Cincinnati and show several pictures of Water Works buildings.



Fig. 1. A map showing the location of the principal parts of the Cincinnati Water Works System.

- b. How the excursion outline is to be used during the excursion.

Lesson VIII. An Excursion to the Water Works at California, Ohio.

OUTLINE FOR OBSERVATIONS.

- a. Intake Pier:
Where situated? Why? How does the water enter?
Where is it sent? How?
- b. River Pumping Station:
How deep? How many pumps? Average amount of water pumped per day? Cost, per million gallons, of pumping the water?
To what point is the water pumped?
- c. Settling Basins:
Capacity? How long does the water stay in the basins?
How much, and what kind of impurities are removed?
How?
- d. Head House:
What use is made here of the water on its way to the filters? Where does it receive the power that makes it able to do this work?
- e. Chemical Houses:
What solutions are made here? Where do they go?
- f. Coagulation Basins:
How many of these basins are there? What is the process of coagulation? What kind, and how much of the impurities does this process remove from the water?
- g. Sand Filters:
How many filters are there? Capacity of each? What are they made of? How much dirt is removed? How many bacteria? How are the filters cleaned? How often are they cleaned?
- h. Clear Water Reservoir:
Where located? Why? Capacity?
- i. Gravity Tunnel:
How long? How deep? Where does it go? What makes the water flow through it?

Lesson IX. Preparation of Material for Reports.

- a. Group 1. On an outline map of Cincinnati (loaned by the Civics Department) indicate with crayon the location of the gravity tunnel, pumping stations, water tanks and auxiliary reservoirs, and the districts of the city supplied.
- b. Group 2. Prepare a diagram (enlargement from the report) showing the decrease of typhoid fever since the present water system began operation.

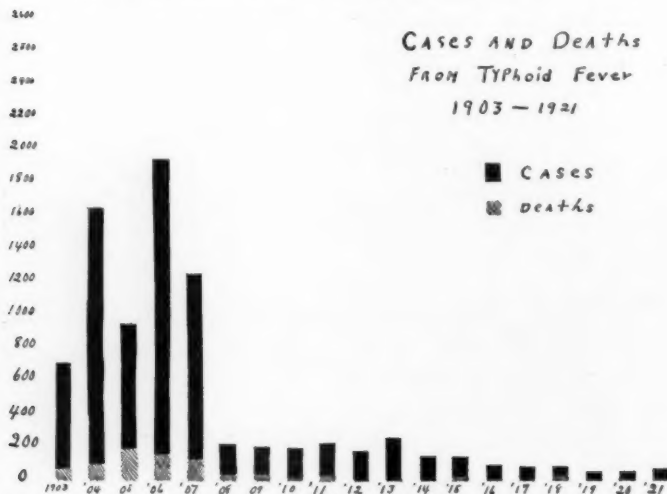


Fig. 2. Typhoid fever.

- c. Group 3. Prepare a diagram (information from a table in the report) showing the increasing pollution of the Ohio River water.

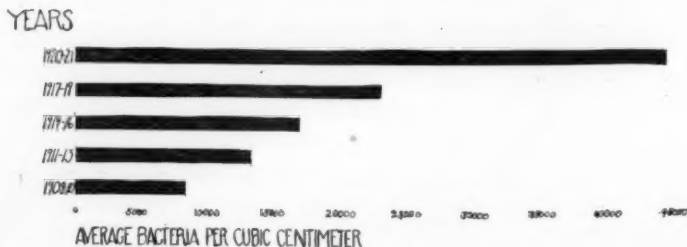


Fig. 3. The increasing pollution of Ohio River water.

- d. Group 4. Prepare tables showing the percentage removal by the Water Works System of:
 - A, bacteria; B, turbidity; C, dissolved solids.
- e. Group 5. Count rice grains for an exhibit comparing the bacteria present in a cubic centimeter of raw river water and filtered water.

Lesson X. What We Have Learned About the Water Works System of Cincinnati.

- a. A cross-section diagram of the whole system is displayed with a map of Cincinnati. The pupils give their reports and the exhibits of groups 1 and 4 are shown.
- b. A simple outline drawing and a brief description are included in the pupils' note books.
- c. Reading assignments: "Water pressure," Van Buskirk and Smith, pp. 82-83; Hodgdon, pp. 263-267, especially the figures; Hessler, p. 208.
- d. Study questions:
 - 1. What methods are used to produce pressure in water pipes?
 - 2. Which of these methods is used in Cincinnati? Indicate examples.
 - 3. What is meant by the expression, "Water seeks its own level?"

Lesson XI. What the Improved Water Supply System Has Done To Improve the Health of the City.

- a. The increasing need of caring for the purity of public water supply; discussion of a diagram showing the increasing pollution of the river water. Report of group 3.
- b. Historical survey of typhoid fever conditions in the city during the years before and since the completion of the present water supply system. Report of group 2, with diagrams.
- c. Rice grain exhibit showing 44,000 grains in one jar, and 22 grains in the other.
- d. Discussion of the tables prepared by group 4.
- e. Regulations on boats and trains. The Cincinnati Sanitary Bulletin, January 10, 1922.

Lesson XII. The Problem of Distributing the Water.

- a. Recitation on previous assignment, including pressure problems.
- b. The reservoir and gravity tunnel. Two glass funnels are connected by means of rubber tubing, and the apparatus nearly filled with water while the funnels are held upright. By changing the position of the funnels the principle of the gravity tunnel may be illustrated.
- c. Pumps: Van Buskirk and Smith, Problem 6, and p. 12.
- d. Assignment: Hodgdon, pp. 273-276, 285-287.

Lesson XIII. Some Home Problems Involved in the Use of Water.

- a. Meters: The measuring mechanism is explained by means of a model borrowed from the Industrial Arts Department.
The class learns to read a meter and report the readings of home meters for several days.
- b. Waste of water: The class finds out at home the amount of water wasted by leaks of various sizes. The class enumerates all forms of wasteful handling of water.
- c. Traps: Purpose and structure. Reports on readings and observations at home.

Why Bread Rises.¹

B. CLIFFORD HENDRICKS, University of Nebraska.

(A lesson for general students upon the simple chemistry of bread making.)

I. CLASS WORK; the preparation for the problem.

Reports from different members of the class upon "kitchen conduct" when cakes, biscuits, omelets or light bread is in the oven. Such an exchange of experiences will bring out the fact that two important desires of the cook are that; (1) all these foods shall rise properly and (2) that the omelet and cake shall not "fall." Sooner or later the question is going to come, "What

¹ This study was developed and grew out of the work of a group of Smith-Hughes teachers taking a course in General Science Methods in the University of Nebraska 1922 summer school.

makes bread, biscuits, cake and omelets rise?" The inability of the *majority* of the class to answer this question satisfactorily makes it the class problem. The writer usually suggests, "Now we'll let our apparatus help us to solve our problem." when the discussion has gone as far as the class can carry it.

II. LABORATORY WORK.

Problem ; What makes biscuits and cake rise?

Before actual laboratory work begins have some member of the class tell how sour milk biscuits are made.

Experiment 1. What does sour milk do to soda in biscuits?

Take about one fourth of a teaspoon full of soda and with it in a test tube place about three fourths of a test tube of whey from sour milk. Using a rubber cork and a glass and rubber delivery tube catch three bottles of the gas. (1) What color is it? Place a lighted candle in the bottom of a tumbler and turn one of the bottles of gas as if to pour it upon the candle. (2) Does it seem to pour? (3) Which is the heavier this gas or air? (4) Why do you think so? (5) What does it do to the candle? (6) Answer the experiment's problem question telling what the material is like.

Experiment 2. How show what this gas is made of?

Into the second bottle of the gas prepared in experiment one plunge a piece of burning magnesium ribbon. When it ceases burning examine the burned part for little black specks. (1) Compare them with powdered charcoal. (2) What color is the other ash? (3) To burn and make ash what gas is needed as well as wood or magnesium ribbon? (4) Since we get the black specks from this gas and yet it makes the ribbon burn even when the air is shut out, what two things does this gas seem to be made of? We shall call this gas *carbon dioxide*, (5) Answer the experiment's problem question.

Experiment 3. How test for this carbon dioxide gas in future experiments?

Into each of two bottles, one containing air the other the carbon dioxide gas caught in experiment one, pour about a teaspoon full of lime water. Shake each bottle. (1) Compare the results in the two bottles. (2) From this what may be said

to be a test for carbon dioxide? (3) Answer the experiment's problem question.

Experiment 4. How would this gas cause baking food to rise?

Bubble some carbon dioxide gas thru some soap bubble solution in a test tube. (1) In what sense does it make the solution rise? (2) Heat the test tube containing the rising soap solution and note the effect. (3) Answer the experiment's problem question.

Experiment 5. What other than sour milk may be used with baking soda to produce carbon dioxide gas?

A. Dissolve some cream of tartar in water. (1) Test it with blue litmus paper. (2) Pour some of this solution into a test tube containing soda and test the gas as in experiment three above.

B. Dissolve some alum and proceed as in A. 1 and 2.

C. Test some sour milk with blue litmus and compare with A. 1 and B. 1 above.

D. Answer the experiments problem question.

Experiment 6. What are baking powders?

Mix some dry powdered alum with some dry baking soda. Put some of this mixture into a test tube. Into another test tube place an equal volume of baking powder. (1) Into each tube pour an equal volume of warm water and compare results. Into each tube drop a few drops of iodine solution. Iodine is a test for starch. (2) Is there starch in either of these test tubes. (3) Could the mixture of soda and alum be used for baking powders? How is it different from the baking powder?

III. CLASS WORK (These are to be prepared during the study period or at home.)

Exercises.

1. What makes biscuits and cake rise and how?
2. Name some other substances that might be used with soda in place of sour milk.
3. How is carbon dioxide gas unlike air in two ways?

4. Can carbon dioxide gas be made from any other solid than baking soda? What?
5. What makes the bubbles in soda water and where does it come from?
6. a. Why do the biscuits rise more rapidly in the hot oven than before?
b. Why does the omelet fall when it gets cold?
7. a. What is the objection of too much soda in biscuits?
b. Too much sour milk?
8. a. Why use starch in baking powder?
b. Why should baking powder "lose strength" in very moist weather?
9. a. What becomes of the carbon dioxide when we eat the cake?
b. What is the effect of heat upon the white of egg?
c. Upon flour gluten?
d. Why does the cake often fall when suddenly jarred or when the oven is not hot enough to start it with?
10. a. Why should we want cakes, biscuits and bread to rise?
b. What is unleaven bread?

IV. LABORATORY WORK.

Problem: What makes the omelet and the light bread rise?

At the beginning of the laboratory period have the steps taken in making an omlet and in preparing a batch of light bread given by some member of the class.

Experiment 7. What makes the omlet rise?

Use the same apparatus and materials as in experiment four except, in this, force air thru the soap solution by use of a bicycle pump. (1) Does the air cause the solution to rise? (2) What effect does heating have upon it? (3) Recall how the omlet is made and answer the experiment's problem question.

Experiment 8. What causes light bread to rise and how is it made? Soak one cake of yeast foam in water until a paste may be made of it. Place 40 grams of molasses in about one half pint of water. Into the molasses solution pour the yeast paste and leave stand in a warm place for four or five hours. (1) Test the gas given off as in experiment three. (2) From its taste what sort of a food is molasses i. e. carbohydrate, fat

or protein? (3) What caused the change in the molasses?
(4) Answer the experiment's problem question.

Experiment 9. What else is produced from the sugar besides yeast other than carbon dioxide?

Leave the solution from experiment eight for two or three days then put into a flask so that a one hole rubber stopper with a glass and rubber delivery tube may be attached. Allow the ends of the delivery tube to end in a test tube surrounded by cold water. Heat the flask to not to exceed 80 degrees Centigrade until the test tube is two thirds full of distillate. Use a smaller flask and reheat and recondense the liquid caught in the test tube above. (1) Smell of this recondensed liquid. (2) Pour some of it into a saucer and touch a lighted match to it. If it burns it is alcohol. (3) Answer the experiments problem question.

V. CLASS WORK. (See III above.)

Exercises.

1. Strictly speaking, does yeast make bread rise?
2. What becomes of the alcohol in the light bread?
3. Will yeast make carbon dioxide out of starch as well as out of sugar?
4. a. What is malt? b. Why is grain sprouted in making malt?
5. Why is sugar put into light bread?
6. Why is light bread kneaded?
7. What causes sour light bread?
8. Why cannot light bread or biscuits be made from barley flour.
9. What is "salt rising" bread?
10. a. Is soda or yeast used in corn bread? b. Why?

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Book Reviews

Interesting Neighbors—Oliver P. Jenkins—288 pages—81 illustrations—\$1.12—P. Blakiston's Son and Company.

"Interesting Neighbors" is a collection of over fifty stories of plant and animal life written for children. It is best characterized perhaps as a nature reader. The material is of a character making the book of value as a nature study supplement. Adults as well as children will be interested in reading this book.

Plane Geometry—C. A. Willis—301 pages—473 illustrations—\$1.32—P. Blakiston's Son and Company.

The presentation of subject matter is interesting, so that pupils will be inspired to read and learn. The text is so arranged that it may be used for a short or a complete course, or it may be used for a laboratory course. A large number of additional theorems, exercises, and reviews offer plenty of extra work for ambitious pupils.

The Science of Common Things—Samuel F. Tower and Joseph R. Lunt—398 pages—numerous illustrations—D. C. Heath & Company.

This is probably the best book of demonstrations in general science yet produced. In scope it is limited to ten projects on common things and the general plan is such as to compel project work if one is to receive the good from the use of the book. Practically everything is taught by class demonstrations, which are handled here in a masterly way. At the chapter ends a few pages of text matter supplement and review of the class demonstrations. The illustrations are for the most part original half-tones of experiments being performed by pupils. These certainly will appeal to high school boys and girls. A list of science books and of equipment needed to carry out the demonstrations are to be found in the back of the book. You will surely want to examine this book, for it has something in it to help you.

Practical Electricity for Beginners—George A. Willoughby—104 pages—55 illustrations—\$1.00—The Manual Arts Press, Peoria, Illinois.

The author has succeeded in presenting a difficult subject so simply that grammar school children will readily understand it. It covers the practical aspects of electricity which everyone ought to be familiar with. The subjects treated are electric currents, conductors, insulators, pressure, circuits, battery lighting circuits, heating effect, fuses, incandescent lamps, electrical measurements, how to detect circuit trouble, and dangers and how to avoid them. It serves either as a text or reference book for classes in shop work or in science.

Introduction to General Chemistry—H. Copaux—Translated by Henry Leffman—195 pages—30 illustrations—\$2.00—P. Blakiston's Son and Company.

This book is limited in its scope to an exposition of the principles of modern chemistry. The discussion of such topics as "Radio Active Transformation," "The Structure of Atoms," "Catalysis," and "Properties and Theories of Solutions." Will appeal to the chemistry teacher who desires knowledge of modern views of chemical theory.

Civic and Economic Biology—William H. Atwood—470 pages—364 illustrations—\$1.68—P. Blakiston's Son and Company.

This latest addition to civic biology follows its predecessors in offering a new viewpoint in science teaching and in giving promi-

Christman's SHOP MATHEMATICS

Here is a book for vocational training which takes up the subject in such a direct and lucid manner that the student who has studied elementary mathematics can easily understand it.

Its original drawings teach mechanical principles, at the same time that they form the basis of the problems. The explanations are simple, and have been successfully tested in the author's own classes.

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The volume includes tables which will be found convenient for reference both in classroom work and later.

Black and Davis' PRACTICAL PHYSICS

The Revised Edition of this well-known text, although only published in May, 1922, is now used in the schools of such cities as :

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nence to the practical phases of the science. It tends, perhaps, a little more toward the pure science organization than the other texts. The book was written primarily for use in the second year of high schools and particularly for students who have had a year of general science. The work is made up of 70 lessons grouped into the following units: how plants and animals live; the relations of life to food; the responses of plants and animals; problems of growth and reproduction; plant and animal breeding; the doctrine of evolution and problems of civic and economic biology.

The Study of Living Things—W. H. D. Meier—96 pages—80 cents—Ginn & Co.

This is an outline of a complete course in biology, and covers all topics required for college entrance. In form it is like a laboratory manual note-book. Many of the exercises are not merely experiments but are projects either for manual execution or for research work in books. Reference or text-books must be used to derive the material here suggested. With each of the 96 topics are given a number of helpful suggestive sub-topics to guide the pupil in his study. One advantage of this method lies in the fact that the specific things which are considered most important in a year's study of biology are distinctively placed before the pupil and then become problems for him to solve.

Radio for Everybody—A. C. Lescarboursa—334 pages—numerous illustrations—\$1.50—Scientific American Publishing Company.

"Radio for Everybody" is written in popular style and gives a large amount of useful information for the average layman interested in broadcast receiving. It omits technical details, but gives one an understanding of the use of the different devices of the radio set and in a superficial way explains how messages can be sent and received. It is a book that every radio amateur will find useful.

High Schools and Sex Education—Edited by B. C. Gruenberg—98 pages—U. S. Bureau of Health Service.

This book, prepared under the joint action of the Government Public Health Service and the Bureau of Education, will be helpful to high school teachers interested in making more effective and useful citizens of the boys and girls who study under them. After a discussion of the general aspects of the subject and the teacher's preparation, specific suggestions are given regarding what can be done in different subjects, as biology, general science, physiology, physical education, home economics, social studies and English. Other important topics are emergency devices and an outline of a summer school course for teachers. A good bibliography of selected reading is also given.

Chemistry and Its Uses—William McPherson and William E. Henderson—447 pages—260 illustrations—\$1.60—Ginn & Co.

This illustrated product of Messrs. McPherson and Henderson is a writer's choice among work on elementary chemistry, while the theoretical side is not slighted the practical uses of chemistry are strongly emphasized. New developments in chemistry are given a place, and the important place they give it takes in every-day and industrial life. Many new and exceptionally fine photographs have been used to illustrate the text. The book is for high school use.

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Forty Notifiable Diseases—Hiram Byrd—paper—74 pages—60 cents—World Book Co.

This book about communicable diseases is a summary of important facts that should be a part of the information possessed by every citizen. It sets forth only those aspects of the subject that a layman can reasonably be expected to assimilate, but at the same time incloses all the facts and ideas that it is desirable for him to know. As a teaching device the diseases are grouped as children's diseases, sewage diseases, diseases spread by suctorial insects, the venereal diseases, diseases contracted from lower animals, diseases spread by carriers, diseases due to filterable versus diseases amenable to immunization. A valuable 10-page glossary follows the text.

Women in Chemistry—paper—272 pages—The Bureau of Vocational Information, New York City.

This is number four of the series "Studies in Occupation." It is a survey of the various kinds of positions available to women in chemistry and the related fields, physiology and bacteriology. Existing conditions are portrayed and friendly advice given to the women about to choose an occupation. The general fields covered are: Educational institutions, medical laboratory, industrial laboratory and government laboratory. A discussion follows of the advantages and disadvantages for women, of training needed, and of salaries that may be expected.

Lecture Demonstrations in Physical Chemistry—Henry S. van Klost—196 pages—87 cuts—Chemical Publishing Company.

This book offers a well selected set of lecture table experiments to illustrate physical chemistry. Not only is the theoretical side well covered, but numerous experiments help explain practical everyday phenomena. Every chemistry teacher will find usable material; here and there are a number of suggestions of value to the general science teacher. The topics treated are: properties of matter; diffusion; osmosis; vapor pressure and molecular weights; catalysis; ionic theory; solubility; colloids and adsorption; actino-chemistry; flames, combustion and explosion; liquid air experiments.

The Geography of New England—Phillip Emerson—96 pages—114 half-tones and maps—The Macmillan Company.

This book gives the story of New England—its land area and bodies of water, its cities and the rural districts. The influence of land forms, water control and climate are discussed in their relation to population and occupation. The industries are given special attention. Numerous specific questions for map study and stimulating thought questions here and there throughout the text are good features of the book. The illustrations are exceptionally fine. It is of junior high school grade.

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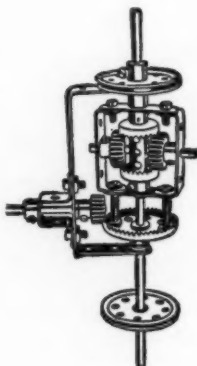
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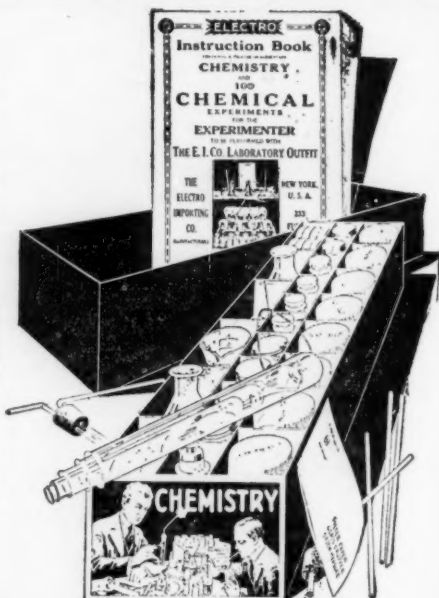
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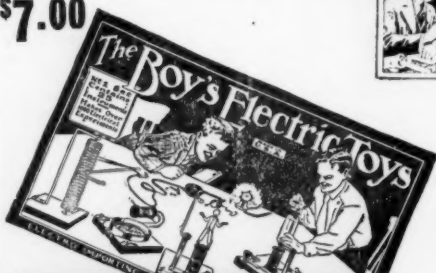
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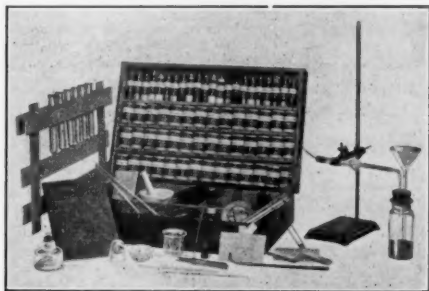
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